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Using the model for improvement to address safety concerns in critical care

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Using the Model for Improvement to Address Invasive Hemodynamic Safety Concerns in Critical Care

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A clinical research project submitted to the Graduate Faculty of

JAMES MADISON UNIVERSITY

In

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For the degree of

Doctor of Nursing Practice

School of Nursing

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FACULTY COMMITTEE

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Committee Members/Readers:

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Acknowledgments

I want to thank Dr. Maria deValpine for all her support and guidance during these uncertain times. I also want to thank my mentor, Dr. Bethann Mendez, for facilitating the implementation of my project in the clinical setting. Last, but certainly not least, I want to thank my entire family for the sacrifices they made and the support they gave while I was on my doctoral journey. I love you!

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Abstract

The use of invasive catheters to monitor hemodynamic readings is common in the critical care setting and requires the use of specialized equipment. Variation in equipment set-up impacts operational efficiency and creates the potential for improper patient treatment based on inaccurate readings. The methodology of setting up and maintaining hemodynamic pressure lines in the local critical care units lacked structural and processional measures, creating the potential for patient harm. Multimodal strategies, guided by the Model for Improvement, were used to increase the use of evidence-based methods for setting up and maintaining invasive hemodynamic lines in the critical care units. A project team was assembled. Related compliance data was collected for two weeks prior to implementation of project interventions. Team members acted as unit champions and assisted with educational activities within their units. All necessary equipment was made readily available to aid enabling behaviors. After two weeks of interventions, data measures were collected for two weeks. Post interventional data showed increased compliance in all areas.

Introduction and Background

The use of invasive catheters to monitor central venous pressure (CVP) and arterial blood pressure is common in the critical care setting (Figg & Nemergut, 2009). CVP is indicative of venous return to the heart and can be used to guide fluid and diuretic administration (Madger, 2017; Baker & Vincent, 2018). Arterial lines provide constant blood pressure readings in unstable patients requiring frequent titration of vasoactive intervascular medications. The use of pulmonary artery catheters to monitor intravascular fluid status and cardiac output is common in certain critically ill patient populations but is less popular than it used to be (Von Rueden, 2020). In units where the use of invasive hemodynamic monitoring fluctuates, ongoing nursing education is necessary in order to maintain skill proficiency (Bridges, 2020). All methods of invasive hemodynamic monitoring require the use of specialized tubing and fluid filled transducers to produce visible waveforms and enable direct value measurements (Polancich, Poe, Von Hagel, & DeMoss, 2015). The use of fluid filled transducers requires proper zeroing and leveling to the phlebostatic axis in order to provide accurate readings. The phlebostatic axis is an external chest landmark which approximates the level of the right atrium and the aortic root (Sjodin, Sondergaard, & Johansson, 2019). If the transducer is not level with the phlebostatic axis, the obtained readings will be artificially high or low (Ortega, Connor, Kotova, Deng & Lacerra, 2017). Invasive hemodynamic values are used to guide patient treatment. Improper set up of the monitoring equipment creates the potential for patient harm secondary to treatment of inaccurate values.

Problem Statement

Variation in pressure transducer set-up impacts operational efficiency and has the potential to negatively impact patient outcomes (Polancich, Poe, Von Hagel, & DeMoss, 2015). Accuracy of invasive hemodynamic readings requires proper marking of and leveling to the phlebostatic axis (Sjodin, Sondergaard, & Johansson, 2019) The methodology used to set up and maintain hemodynamic pressure lines in the local critical care units was not evidenced based, creating the potential for inaccurate readings, implementation of inappropriate treatments, and potential patient harm. Factors related to the problem included the lack of a standardized workflow, necessary equipment, and on-going competency testing.

Purpose and Aim

The purpose of this study was to plan, implement, and evaluate multimodal strategies to increase the use of evidence-based methods for setting up and maintaining hemodynamic monitoring lines in the critical care units of the local hospital. The aim was to improve patient outcomes by providing accurate assessment data to guide patient treatment and reducing the potential for patient harm.

Review of Literature

The October, 2019 issue of AACN Bold Voices reported critical care nurses are inconsistent in determining the correct external anatomical area for transducer placement. This creates the potential for inaccurate readings, implementation of incorrect treatment modalities, and the potential for patient harm (Sjodin, Sondergaard, & Johansson, 2019). In order to provide accuracy in measurement trending, the location of the phlebostatic axis needs to be located and marked with a skin pen when invasive hemodynamic

monitoring is initiated (Rauen, et al., 2009). This enables all nurses to use the same reference point for leveling. A 2011 study by Vincent et al. determined hemodynamic monitoring is only able to improve patient outcomes if the obtained data is accurate and relevant to the monitored patient. If the data is interpreted incorrectly, the treatment applied may result in patient harm. Monitoring in and of itself does not improve patient outcomes (Muller, et al., 2012). In 2009, Figg and Nemergut determined the greatest variability in transducer placement occurred when the patients were positioned with the head of the bed elevated 30 degrees. This is a common patient position in critical care units because it has been determined to decrease ventilator associated pneumonia and tube feeding aspiration.

A second patient safety problem related to improper set-up of hemodynamic monitoring systems is the potential for hemorrhage and air embolus introduction. Pressure tubing is packaged with vented caps on the stopcocks. This is necessary for adequate sterilization prior to packaging. It allows the user to prime the system without first removing the caps. Non-vented caps are included in the packaging and must be applied after the system is primed. If the non-vented caps are not applied and a stopcock is turned open to air, there is the potential for exsanguination in an arterial monitoring system, and introduction of air into a venous monitoring system (Ortega, Connor, Kotova, Deng, & Lacerra, 2017).

Von Bueden (2020) identified the need for ongoing educational activities regarding the use of invasive hemodynamic lines. She noted the gap between clinical practice and evidence based recommendations may be attributable to decreased use of certain types of catheters resulting in loss of nursing proficiency.

Project Design

The Model for Improvement was used to guide this quality improvement project. The Model for Improvement is based on the scientific method and used for action oriented learning. In this model, an opportunity for improvement is recognized, change is implemented, and the results are then analyzed. Based on the results, alterations are made or the intervention is built upon further. Project aim, measures, and needed changes are identified and then tested, utilizing the Plan-Do-Study-Act (PSDA) cycle to determine if improvements were made (Institute for Healthcare Improvement, 2012).

To gain insight into the patient population, workflow, and unit environment, the team leader provided patient care for 5 days in the critical care units. During this time, the improper set-up and leveling of the hemodynamic transducers was observed. Patient therapies were initiated based on inaccurate readings secondary to unleveled transducers. One patient received multiple fluid boluses for an inaccurate blood pressure reading that later necessitated the administration of diuretics. Another patient with an unleveled transducer was started on an intravenous vasopressor which resulted in a period of hypertension. The director and educator of the critical care units agreed the observations were problematic and needed to be addressed.

The improper set-up of monitor transducers had become the social norm in the units. Multiple factors played a role in this behavior. Necessary equipment was not readily available to set up the systems correctly. There were two levelers available for 48 rooms. Teaching the skill was primarily done by nursing preceptors and recommended clinical practice was not often role modeled. The majority of the nursing staff have less than five years of work experience (2018 Magnate Designation Data, WMC). The use

and rationale for hemodynamic monitoring was taught via an online learning module during orientation and does not include hands-on testing. The skill was not being included in annual competency reviews.

The number of patients receiving invasive hemodynamic monitoring and the types of monitoring used fluctuates from unit to unit. Different types of equipment may be used based on the type of monitoring being done. Inconsistent use can lead to knowledge gaps and the need for ongoing training to maintain skill proficiency (Von Rueden, 2020).

The electronic health record does not have required documentation or reminder prompts for basic hemodynamic monitoring interventions. The order set does not include a space for locating and marking the phlebostatic axis. There is also no way to chart the replacement of vented caps with non-vented caps in the order set. A fishbone diagram displaying problem causational factors is located in Appendix A.

In 2015, Polancich, Poe, Von Hagel, and DeMoss determined variation in pressure transducer set-up impacts operational efficiency and negatively impacts patient care. They recommended the establishment of a standardized workflow for equipment set-up and management. Nurses use different anatomical landmarks for determining the location of the phlebostatic axis. This prevents accurate trending of resulting values, creating a patient safety risk if the values are used to guide treatment (Sjodin, Sondergaard, & Johansson, 2019).

Methodology

This project was quasi-experimental in design, with compliance data collected two weeks prior to the interventions and again, two weeks afterward. It was guided by the Model for Improvement, which was developed in 1996 by the Institute for Healthcare

Improvement. The model utilizes rapid cycle processes to develop, test, and implement changes to create improvement (Institute for Healthcare Improvement, 2012). The rapid cycle format aligned well with the project timeframe, which had to be condensed secondary to Covid-19 influence.

The foundational aim, measures, and necessary changes were identified and used to develop the project plan. The aim was to have the nurses in the critical care units utilize best practice methods to set up and maintain invasive hemodynamic pressure lines. Three process measures were identified as necessary to achieve that aim: the nurse located and marked the phlebostatic axis at the start of treatment; the nurse leveled all transducers, using a leveling device at appropriate times; and the nurse replaced all vented caps with non-vented caps when pressure tubing was assembled.

Three main change interventions were chosen for the first Plan-Do-Study-Act (PDSA) cycle. Necessary equipment needed to be made available. There were only two levelers available for 48 patient beds. Educational activities were needed to address knowledge gaps in the nursing staff. Role modeling of the desired behavior by established clinicians was needed to promote adoption of the desired behavior change.

Setting

The project took place in a 445 bed regional referral hospital which serves more than 400,000 residents from nearby rural areas in the eastern part of the country. The hospital has 48 critical care beds which are divided into four separate units. The hospital employees 127 critical care nurses. Each unit has a nursing leader, and each division has a nursing educator and a nursing director. The average nurse to patient ratio is 1:1 or 1:2, based on patient acuity. The four units care for adult critical care patients only.

Plan

Human and material resources were needed to implement the project. Established clinicians from each unit were needed to act as unit champions. The role of the unit champions was to assist with educational activities, act as resources, and serve as role models of the desired behavior. I was able to find nurses willing to act in this role by spending time in the units and interacting with the staff in an informal manner. Acting as a unit champion was presented as a way to participate in a quality improvement project which could then be used for advancement on the hospital clinical ladder.

Leveling devices and skin marking pens were the material resources needed for the project. 48 metal meter sticks, leveling bubbles, and sharpie pens were purchased. The leveling bubbles were glued to the meter sticks using super glue. A plastic cable tie was attached so the leveler could be hung from an IV pole. All materials could be sanitized to comply with hospital standards. Having the necessary equipment readily available promotes enabling behaviors (Green & Kreuter, 2005).

Budget

The budget for the project implementation included the materials necessary to assemble the levelers, purchase skin marking pens, and provide gift cards for participation. The sample equipment was provided by the hospital.

Estimated Costs for Project

Materials	Cost per Unit	Number of Units	Totals
Metal meter sticks	$2.87	48	$137.76
Gorilla Glue	$4.84	1	$4.84
Cable Ties	$5.42	1	$5.42
Leveling Bubbles	$1.74	48	$83.28
Sharpie Pens	$0.84	48	$40.00
Coffee gift cards	$5.00	70	$350.00
Total			**$621.30**

Sample Population

Purposive sampling was used and included all 127 critical care nurses employed by the hospital. Assistive personnel do not utilize the equipment and were excluded from the sample. Participation in the educational activities was encouraged by the unit champions and the critical care educator, who sent out two emails asking the nurses to complete the online module. A five dollar gift card to Starbucks was given to everyone who completed the module as an additional incentive. The cards were distributed by the unit champions. A flyer advertising the gift card was posted in all the units (Appendix B).

Ethical Consideration and Consent

IRB approval was obtained from both James Madison University and the hospital review board (Appendix C). The critical care director and critical care educator agreed the project would be beneficial and they would assist with its implementation.

Implementation

Pre-interventional data was collected on fifteen days between July 25, 20202 and September 5, 2020 . The project team measured the following variables via chart review: were the transducers leveled to the phlebostatic axis, were the transducers zeroed, were the associated patients receiving IV vasoactive medications? Additional variables were obtained via observation. These included dead end caps in place, phlebostatic axis marked, tubing labeled, and tubing in date. All data was recorded using a data collection tool designed by the team leader (Appendix D). Data was recorded based on unit and room number; no patient identifiers were used.

Barriers

Covid-19 was a barrier to the project implementation. The PDSA cycles had to be shortened and one of the critical care units was excluded from pre-interventional data collection. The Critical Care Rapid Assessment Unit was designated the Covid Intensive Care Unit and no one was allowed to enter the unit except to provide direct patient care. Working in a large organization with complex role responsibility prevented the team from creating task reminders in the electronic health record within the timeframe of the project.

Education

An educational Halogen slide show was developed by the team leader based on American Association of Critical-Care Nurses (AACN) recommendations for best practice (Von Rueden, 2020). To encourage participation, the educational slide show was limited to seven slides, followed by a six question quiz. The quiz questions aligned with the project learning objectives (Appendix E). Participants were allowed to take the quiz multiple times to enable learning from incorrect answers. Two references were made available to each unit. Trifurcated pressure tubing which is used to monitor pulmonary artery pressure, central venous pressure, and arterial pressure is the most complex to set up. A sample of this set up was constructed and left in each unit as a visual reference. A step by step written checklist designed by the research team was developed, laminated , and placed with the sample set up in every unit for use as a written reference (Appendix F). Providing multifaceted interventions promotes skill acquisition and increases the likelihood of behavior adoption (Green & Kreuter, 2005).

Timeline

January, 2020: Met with critical care director and educator to obtain support

Spring, 2020: Formed project team

Fall, 2020: Obtained IRB approval and started pre-interventional data collection

October, 2020: Launched project interventions

November, 2020: Began post-interventional data collection

December, 2020: Data analyzed and first PDSA cycle results disseminated

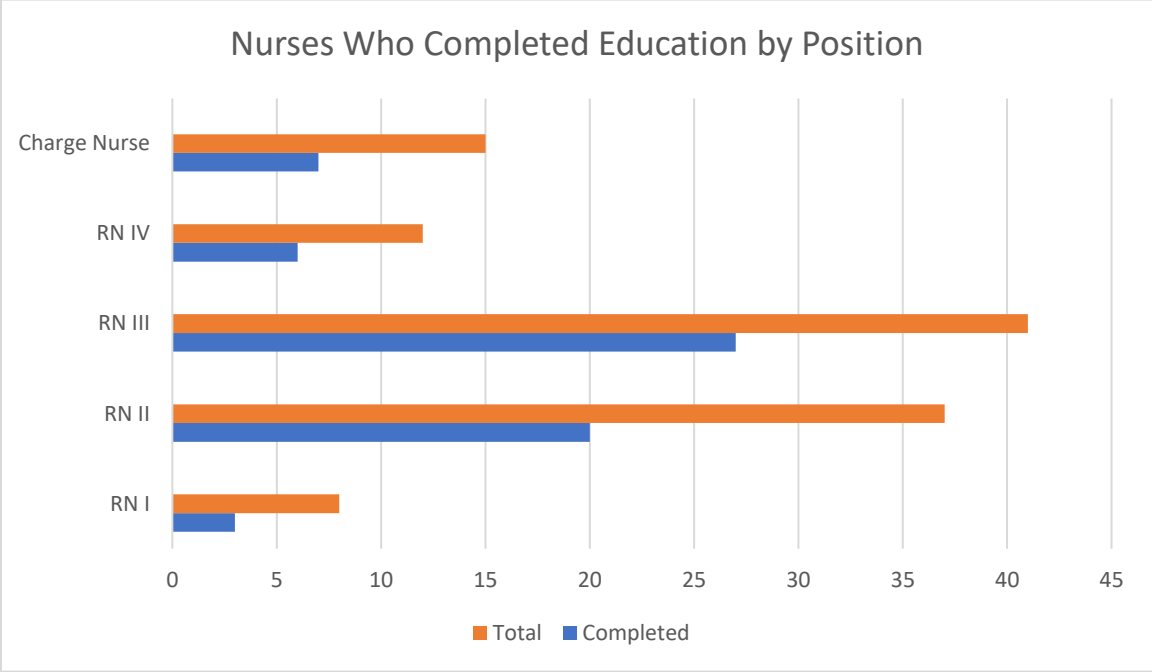
Data Collection

The same data collection tool used to record pre-interventional data was used to collect post-interventional data. The same variables were included and the data was collected over a fourteen day span, from November 2, 2020 until November 19, 2020. The information was obtained by both chart reviews and personal observations. All patients receiving invasive hemodynamic monitoring were included. Data was collected by the unit champions and entered into an excel spreadsheet by the team leader. Demographic data was collected on the nurses who completed the Halogen module.

Results

Pre-interventional data revealed the use of hemodynamic transducers to be evenly distributed throughout the critical care units included in the project. 98% of the transducers were connected to arterial lines, 24% to central venous lines, and 12% to pulmonary artery lines. Based on the chart reviews, 51% of the transducers were leveled and 45% were zeroed. 60% of the vented caps were replaced with non-vented caps and zero patients had the phlebostatic axis marked.

Figure 1



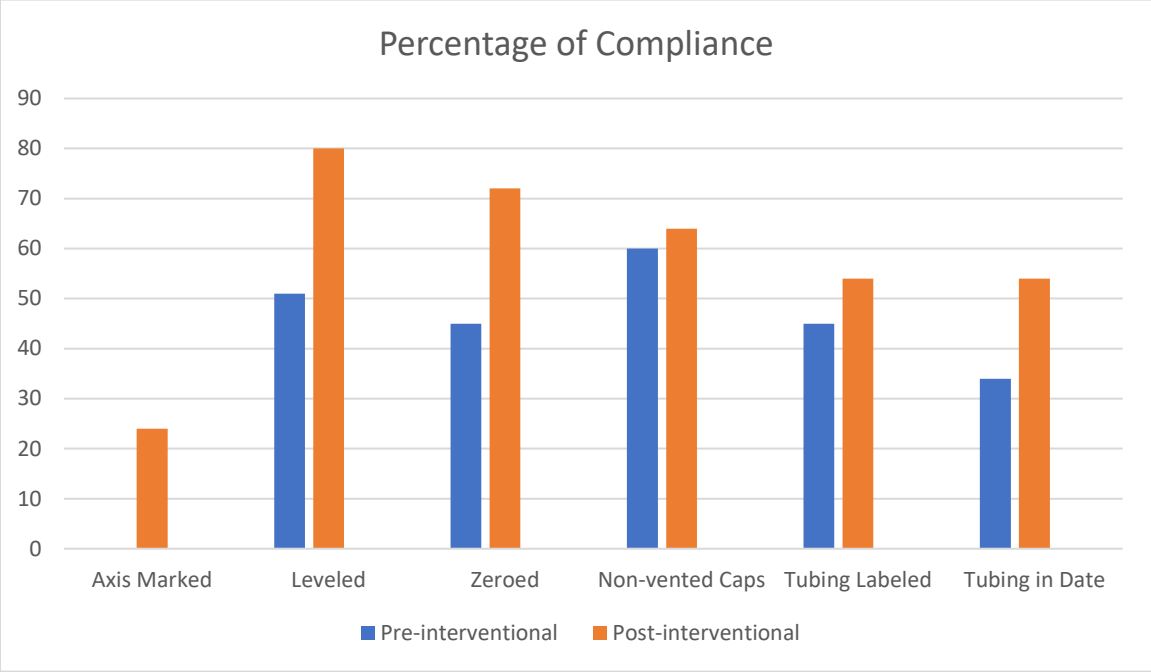
55% of the critical care nurses completed the Halogen educational activity. 62% of male nurses completed the activity, compared to 54% of female nurses. Novice nurses had the lowest level of participation at 30%.

Post-interventional data revealed similar catheter type distribution as before. There were increases in all compliance measurements, with the greatest increase noted for leveling of the transducers. SAS version 27 was used for statistical analysis, with the p level set at 0.05.

Paired Samples Test Results

Measurement	t	df	Sig. (2-tailed)
Phlebostatic Axis Marked	3.130	49	.003
Leveled	3.656	49	.001
Zeroed	3.466	49	.001
Caps Changed	.207	49	.837

Figure 2



Conclusions and Recommendations:

The purpose of the project was to increase the use of evidence-based methods for setting up and maintaining invasive hemodynamic catheters. The pre-interventional data confirmed the need for a quality improvement project. There was zero compliance in the evidence-based recommendation of marking the phlebostatic axis and most of the other measures were being completed less than 50% of the time. Vasoactive drips were being used in 81% of the studied patient population but only 51% of the transducers were leveled. This illustrates the potential for inaccurate readings and improper treatments.

The Halogen demographics showed only 30% of novice nurses completed the educational activity. This may be secondary to feeling intimidated by the material, instead of viewing it as an opportunity to learn. To improve novice nurse participation

during the second PDSA cycle, the unit champions will seek out new nurses and encourage them to participate.

While there were gains in all the compliance measures, there is still room for improvement. The AACN recommendation for marking the phlebostatic axis in order to obtain accurate trending of values is only being done 24% of the time. The data showed an average of 84% of these patients are receiving vasoactive drips. Proper titration requires accurate trending of values. Having a related reminder in the electronic health record could aid in improving nursing compliance. Changing the electronic health record is a complicated process which was unattainable during the limited timeframe of the project. It is recommended the task reminder be added for future PDSA cycles.

Compliance measures increased by 24 – 29% for the objectives which addressed proper leveling of the transducers. Having a leveler readily available resulted in improved compliance. Compliance for the objective of replacing all vented caps with non-vented caps only improved by 4%, and was the only measure whose increase was not statistically significant. There are several possibilities for this outcome. Many of the transducers are set up in the operating room, so once the patient arrives on the unit the packaging and caps are no longer available. Individually packaged caps are stored in the equipment rooms but they are not easily found. Placing the caps in the nurse server of all patients' rooms would make them more assessable and is a recommendation for the next PDSA cycle.

While not a primary objective of the project, the tubing labeling and tubing in date measures showed increased compliance. Potential influencing factors include

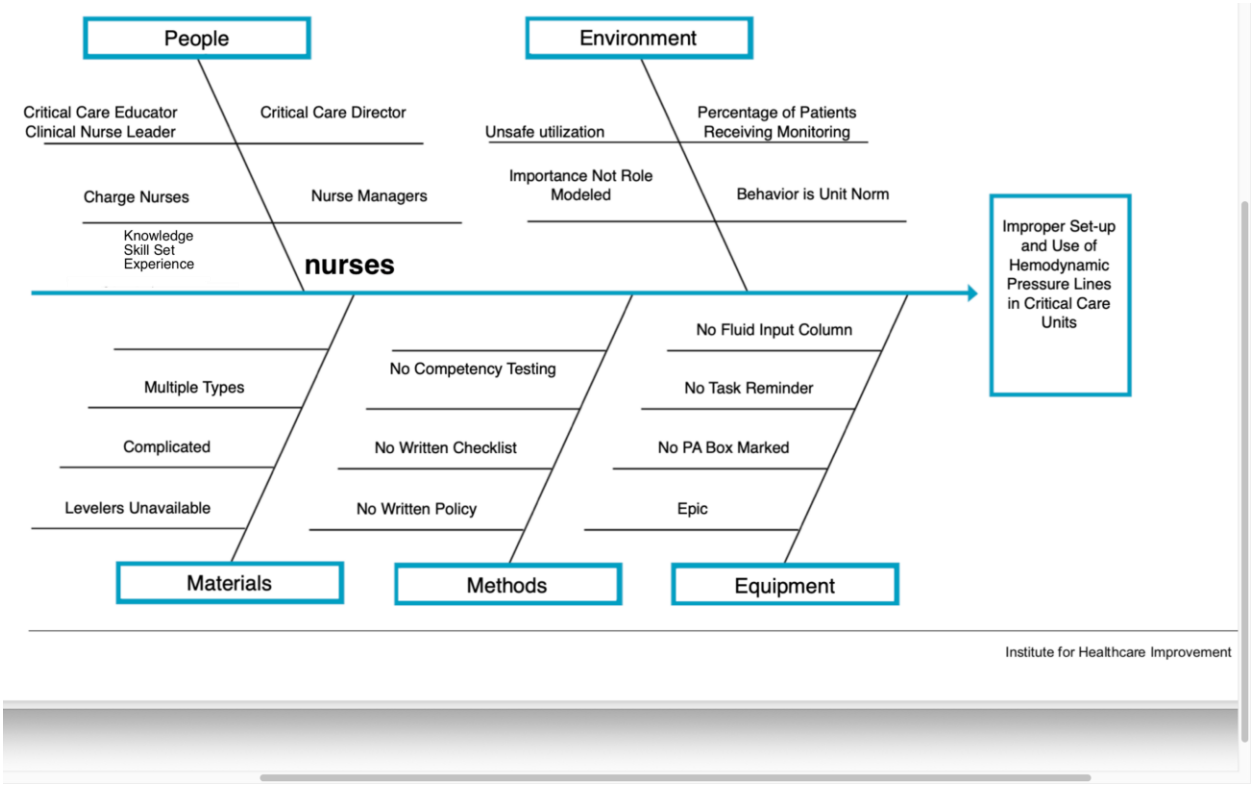
increased knowledge secondary to the Halogen module, role modeling by the unit champions, and awareness of project related surveillance.

Future recommendations include adding the set-up and maintenance of invasive hemodynamic lines to annual skill competency checkoffs and to preceptor checklists. This would prevent development of knowledge gaps and ensure preceptor proficiency. Pulmonary artery catheters made up 12% of the studied lines and are the most difficult to set up. Ongoing educational activities are necessary to maintain nursing proficiency when the catheter type is not used on a regular basis (Von Rueden, 2020). Charge nurse inspection reviews could also improve compliance.

Outcome data was disseminated to the unit director, unit educator, unit managers, and staff nurses via team meetings, huddle presentations, and flyers (Appendix G). A second PDSA cycle is currently being planned.

Appendix A.

Fishbone Diagram



Appendix B.

Incentive Flyer

Please complete the Halogen on obtaining hemodynamic readings. The module is short and should take less than 5 minutes. A $5 gift card to Starbucks will be given to everyone who completes it.

Thank you!! Selena

Appendix C. – IRB Approval

ValleyHealth

P.O. Box 3340
Winchester, Virginia 22604

540-536-8000

September 30, 2020

Selena Truban, MSN, RN, CCRN-K
Shenandoah University School of Nursing
1460 Shenandoah University Drive
Winchester, VA 22601

RE: Using the Model for Improvement to Address Invasive Hemodynamic Safety Concerns in Critical Care

Dear Selena Truban:

The Institutional Review Board of the Valley Health/Winchester Medical Center IRB has approved your study for a period of one year.

Application type & WMC IRB File	**Expedited Review**	**20201001**
Expiration date for this study is:		**09/30/2021**

The IRB policies require that a report be submitted at the closure of this study. The following information regarding the patients you enroll in the study must be included in the report: total number of patients enrolled, completing and dropped from the study, reasons for patients dropped from the study, any adverse events experienced by patients enrolled in the study, and any perceived benefits derived by patients enrolled in the study.

This approval is valid for 1 year. Should an extension be required, an annual report will need to be submitted along with other required IRB documentation.

The IRB is organized and operated by Policies and Procedures as set forth in the Federal Register. This is to certify that the following Institutional Review Board/Ethics Committee is in compliance with Good Clinical Practice Guidelines as defined by the U.S. Food and Drug Administration under the Code of Federal Regulations (21 CFR Parts 50 and 56; 45 CFR Part 46) and International Conference on Harmonisation (ICH) Guidelines (Section E6). IRB00006173, expiration date April 10, 2022 and FWA00015109, expiration date April 3, 2024.

Sincerely,

Jeffrey Skiles, M.D.
IRB Chairperson
WMC/Valley Health IRB

Appendix D.

Excel Spreadsheet for Data Collection

Invasive Hemodynamic Monitoring 1 - CC1 2-CC2 3 - CC3 4 - CC4

1- Yes
2 - No
3 - Discontinued 4 - No Info

Unit Census														
	Day 1						Initial Setup							
	Night 2			**A Line**	**CVP L**	**Swan**	Phlebostatic	Was It	Was It	Deed Caps	Tubing	Tubing	Vaso Active	Comments
							Axis Marked	Leveled	Zeroed	In Place	Labeled	In Date	Drip Present	
Date	Shift	Room #	CC											

Appendix E.

Halogen PowerPoint

INITIAL SET-UP OF PRESSURE TUBING

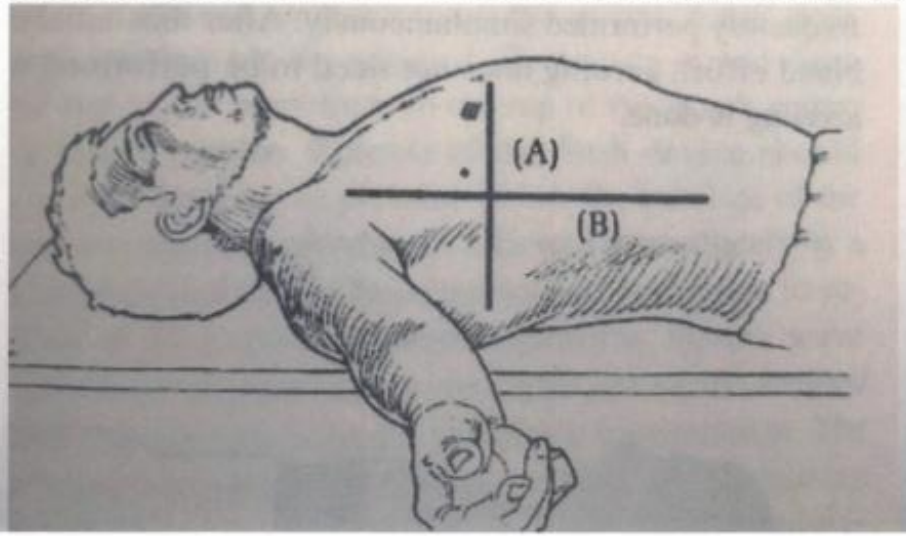
- THE USE OF INVASIVE HEMODYNAMOC MONITORING IS COMMON IN THE CRITICAL CARE SETTING. THE READINGS OBTAINED ARE USED TO GUIDE PATIENT TREATMENT.
- IN ORDER FOR THE READINGS TO BE ACCURATE, SEVERAL THINGS NEED TO BE DONE WHEN THE LINES ARE INSERTED AND THE EQUIPMENT IS SET UP
- THE PHLEBOSTATIC AXIS NEEDS TO BE LOCATED AND MARKED ON THE PATIENT USING A SKIN PEN
- THIS ALLOWS ALL NURSES TO USE THE SAME REFERENCE POINT FOR ZEROING AND ALLOWS FOR ACCURATE TRENDING OF READINGS

PHLEBOSTATIC AXIS

- ALL TRANSDUCERS NEED TO BE LEVELED TO THE MARKED PHLEBOSTATIC AXIS USING A LEVELER
- IF THE TRANSDUCER IS TOO LOW, THE READINGS WILL BE ARTIFICIALLY HIGH
- IF THE TRANSDUCER IS TOO HIGH, THE READINGS WILL BE ARTIFICIALLY LOW
- IF THE PATIENT'S POSITION CHANGES, THE TRANSDUCER NEEDS TO BE RELEVELED
- THE PHLEBOSTATIC AXIS IS USED AS THE REFERENCE POINT BECAUSE IT APPROXIMATES THE LEVEL OF THE RIGHT ATRIUM AND THE AORTIC ROOT

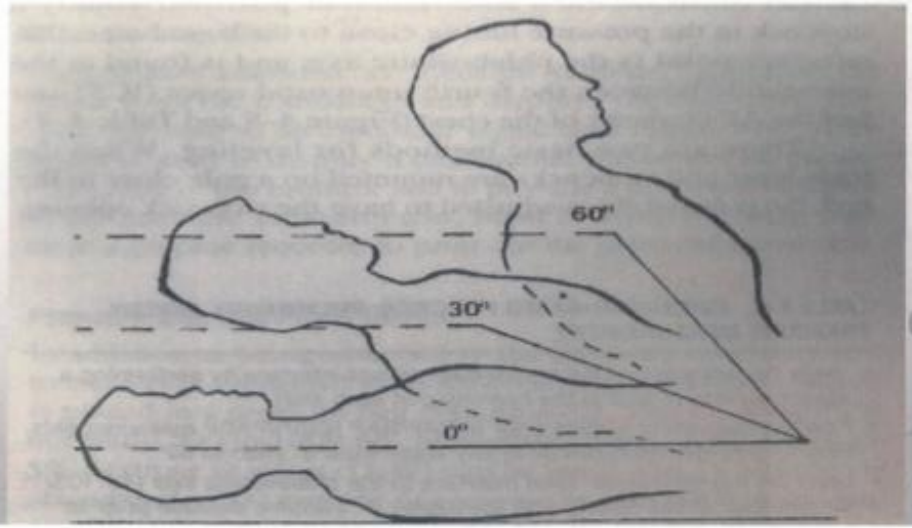
PHLEBOSTATIC AXIS LOCATION

- THE PHLEBOSTATIC AXIS IS LOCATED AT THE 4TH INTERCOSTAL SPACE, MID-CHEST LINE



LEVEL OF THE HEAD OF THE BED

- THE HEAD OF THE BED NEEDS TO BE 60% OR LOWER IN ORDER FOR THE HEMODYNAMIC READINGS TO BE ACCURATE



INITIAL SET-UP

- HEMODYNAMIC LINES NEED TO BE ZEROED WHEN THEY ARE INITIALLY SET UP AND ANY TIME THE PRESSURE TUBING IS CHANGED
- VENTED CAPS NEED TO REPLACED WITH DEAD END CAPS IN ORDER TO MAINTAIN PATIENT SAFETY
- LEAVING VENTED CAPS IN PLACE PUTS THE PATIENT AT RISK FOR INFECTION, ACCIDENTAL BLOOD LOSS, AND AIR EMBOLI

CHANGE THE CAPS WHEN YOU SET UP THE LINES!

CHANGING THE TUBING

- PRESSURE TUBING SHOULD BE CHANGED EVERY 96 HOURS TO PREVENT INFECTION AND MAINTAIN SYSTEM PATENCY
- ALL TUBING SHOULD BE LABELED
- EACH LINE ATTACHED TO THE PRESSURE TUBING AND FLUSH BAG RECEIVES 3ML OF CONTINUOUS FLUSH EACH HOUR

QUIZ

- TRANSDUCERS NEED TO BE LEVELED TO THE PHLEBOSTATIC AXIS IN ORDER TO OBTAIN ACCURATE HEMODYNAMIC READINGS. THIS IS BECAUSE THIS AREA OF THE CHEST APPROXIMATES WHICH OF THE FOLLOWING?
- 1. THE RIGHT ATRIUM AND RIGHT VENTRICLE
- 2. THE LEFT ATRIUM AND LEFT VENTRICLE
- 3. THE AORTIC ROOT AND LEFT ATRIUM
- 4. THE AORTIC ROOT AND RIGHT ATRIUM

- WHERE IS THE PHLEBOSTATIC AXIS LOCATED?
- 1. AT THE 3RD INTERCOSTAL SPACE/MIDCLAVICULAR LINE
- 2. AT THE 4TH INTERCOSTAL SPACE/MID-CHEST LINE
- 3. AT THE 3RD INTERCOSTAL SPACE/MID-CHEST LINE
- 4. AT THE 4TTH INTERCOSTAL SPACE/MIDCLAVICULAR LINE

- HEMODYNAMIC TRANSDUCERS SHOULD BE LEVELED
- 1. ONLY WHEN THE SYSTEM IS FIRST SET UP
- 2. ONCE A DAY
- 3. ONCE A SHIFT
- 4. EVERY 4 HOURS

- IT IS NECESSARY TO LOCATE AND MARK THE PHLEBOSTATIC AXIS ON THE PATIENT USING A SKIN PEN BECAUSE (SELECT ALL THAT APPLY)
- 1. IT ALLOWS FOR ACCURATE TRENDING OF READINGS
- 2. IT ENSURES ALL NURSES USE THE SAME REFERENCE POINT FOR LEVELING PURPOSES
- 3. IT PREVENTS ACCIDENTAL BLOOD LOSS
- 4. IT AIDS IN PREVENTING CATHETER RELATED INFECTION

- WHICH OF THE FOLLOWING CAN OCCUR IF AN ARTERIAL LINE IS NOT LEVELED TO THE PHLEBOSTATIC AXIS? SELECT ALL THAT APPLY
- 1. THE BLOOD PRESSURE READING MAY BE ARTIFICIALLY HIGH
- 2. THE BLOOD PRESSURE READING MAY BE ARTIFICIALLY LOW
- 3. THE NURSE COULD TITRATE VASOACTIVE DRIPS BASED ON AN INACCURATE BLOOD PRESSURE
- 4. THE NURSE COULD ADMINISTER AN UNNECESSARY FLUID BOLUS

- LEAVING VENTED CAPS IN PLACE ON PRESSURE TUBING CAN RESULT IN WHICH OF THE FOLLOWING? SELECT ALL THAT APPLY.
- 1. ACCIDENTAL BLOOD LOSS
- 2. AN AIR EMBOLUS
- 3. PATIENT INFECTION
- 4. INACCURATE READINGS

Appendix F.

Step by Step Checklist

Transducer System Setup

Equipment:
Bag of normal saline (either 500 mL or 1000 mL depending on the size of the pressure bag)
Pressure infusion bag
Pressure tubing with disposable transducer
IV pole and transducer mount
Leveling device
Sterile non-vented stopcock caps
Skin pen

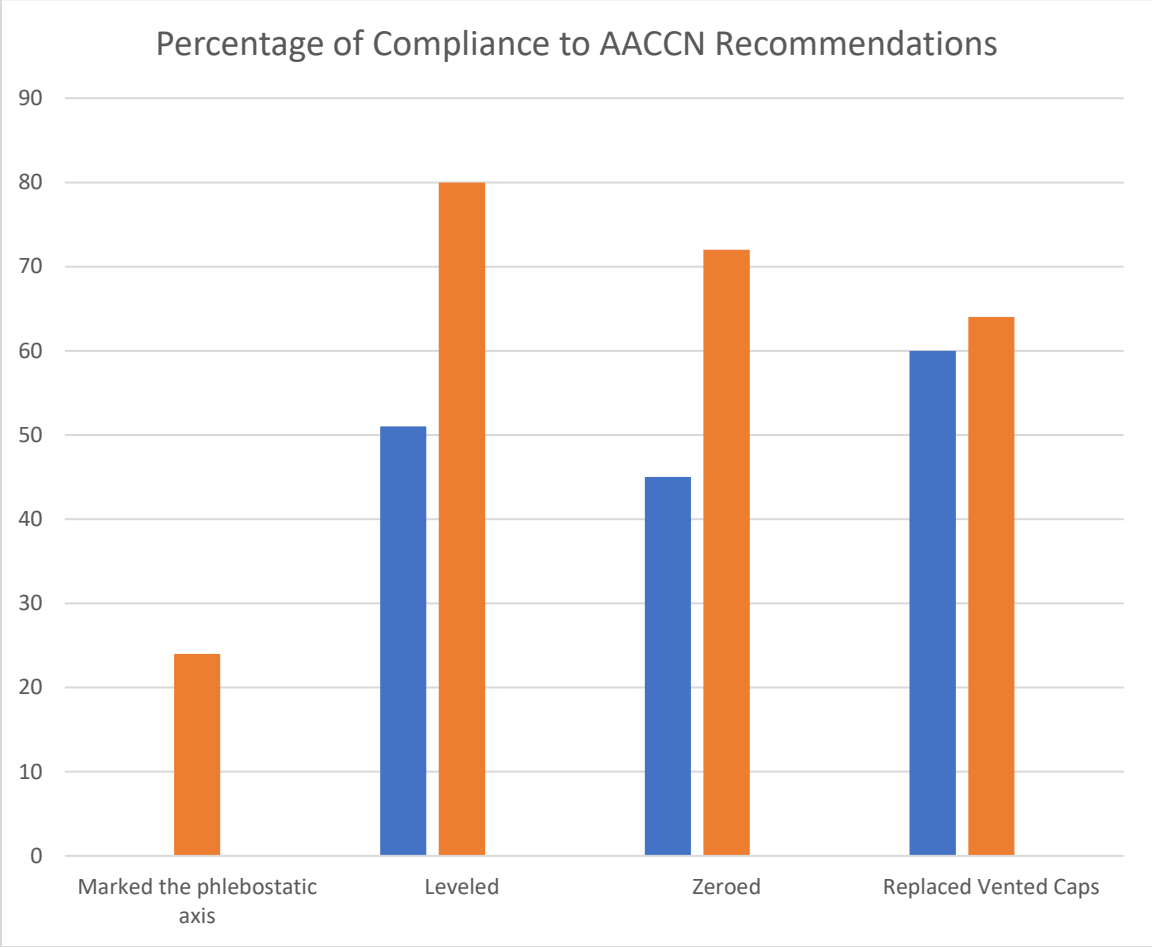
Procedure:

1. Remove pressure tubing from package
2. If necessary, connect the pressure tubing to the transducer
3. Tighten all tubing connections
4. Roll the tubing flow regulator to the "off" position
5. Spike the flush bag, invert the bag, open the clamp, and squeeze all the air through the drip chamber
6. Compress the drip chamber, filling it halfway with the flush solution and reclose the clamp
7. Place flush bag inside pressure bag – do not inflate -priming the tubing under pressure can result in air bubbles in the system
8. Open the flow regulator and prime the system, including the stopcock ports, using the continuous flush device
9. After the system has been flushed, replace all vented caps with dead-end caps
10. Inflate the pressure bag to 300 mm Hg
11. Attach transducer to monitor
12. Locate the phlebostatic axis on the patient and mark with a skin pen
13. Level the transducer to the phlebostatic axis
14. Zero the transducer by turning the system off to the patient, opening the mounted stopcock to air and pushing the zero button on the monitor
15. Label tubing and change every 96 hours

Based on AACN 2020 Recommendations

Appendix G.

Invasive Hemodynamic Monitoring Project
First Cycle Results



Blue: Before Project
Orange: After Project

All changes were statistically significant except for replacing vented caps. Please continue to mark the chest, level the lines, and change the caps! Your actions make a difference and keep your patients safe!

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